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# Facilities Standardization: Improving a Successful Program

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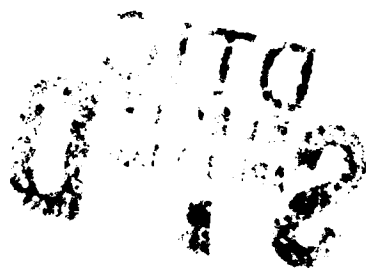
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Jeffrey A. Hawkins  
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## **Executive Summary**

### **FACILITIES STANDARDIZATION: IMPROVING A SUCCESSFUL PROGRAM**

The U.S. Army Corps of Engineers (USACE) performs more than \$2 billion worth of design and construction every year through the annual military construction appropriations. Since 1985, the USACE has used the Department of the Army (DA) Facilities Standardization Program to implement a comprehensive design standardization program. In that 6-year period, the program has been managed by committees and subcommittees of Army operational and functional proponents, USACE technical proponents and Centers of Standardization, and the USACE Architectural and Planning Branch.

Thus far, the program has achieved many of its objectives. It has ensured consistent quality, appearance, and functional productivity and has simplified and reduced the time needed to plan, program, design, and construct new facilities. However, the DA Facilities Standardization Program can be even more effective. Although reducing design and construction costs is a stated objective of the USACE program, the responsible Centers of Standardization and implementing USACE districts are typically not aware of opportunities to do so and therefore do not take the necessary action to promote reduced costs.

In this era of decreasing military construction funding, USACE must use every opportunity to design and construct new facilities as cost-effectively as possible while maintaining a consistently high level of quality. Design standardization can help meet both of those objectives. We recommend that USACE take the following actions to ensure the objectives of DA Facilities Standardization Program are met and that potential design and construction savings are being realized:

- Headquarters, USACE should develop a formal process for selecting the types of facility to standardize and the level at which to standardize the designs of those facilities. This process should include a structured cost-benefit approach that recognizes the additional costs to standardize a design and all the potential cost savings. A set of decision rules and the cost-benefit

approach should be incorporated into the current Standing Operating Procedures.

- When contracting out the design of projects utilizing standard designs, USACE Districts should select architect-engineering (A-E) firms that are familiar with the particular standard facility being designed. By including "experience with the proposed facility type" in the selection criteria, Districts can create an opportunity for realizing lower design fees during the negotiations that follow.
- Headquarters, USACE should create a data base of A-E firms and construction contractors that have satisfactorily completed projects utilizing standard facilities. These experienced firms should be included on the bidder lists for similar facilities.
- Headquarters, USACE should develop a program to better inform its Districts and facility users of the objectives and potential benefits of design standardization. The success of its design standardization program depends on all the participants fully embracing the concept. We recommend that Headquarters, USACE prepare an information brochure that describes the program and disseminate it widely to potential users of standardized designs. Concurrently, it should update existing standardization program documentation to reflect current guidance.
- Headquarters, USACE should further investigate the opportunities that computer-aided design brings to the standardization program. An approach that is effectively used by some organizations is to create a "kit-of-parts" made up of coordinated modules that can be mixed and matched and that provide an extremely flexible design. USACE should examine the cost-effectiveness of using a kit-of-parts approach when selecting facilities to standardize.

By implementing these recommendations, USACE will ensure that the DA Facilities Standardization Program continues to support the Corps' objectives effectively and maximizes both the tangible and intangible benefits that it offers USACE and the Army.

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## CHAPTER 1

### INTRODUCTION

#### BACKGROUND

One of the primary responsibilities of the U.S. Army Corps of Engineers (USACE) is to design and construct military facilities for the Army. That design and construction, which is funded through the annual military construction (MILCON) appropriation, costs more than \$2 billion a year. In FY91, about \$90 million of those funds was appropriated for planning and design (P&D) to support USACE's design effort. Some of Army's facilities are *standardized*, which means that although they are not necessarily identical, the shape, form, and, interior relationships are common from one facility to the next. Design standardization is a program that takes successful designs and/or elements of a particular facility type and uses them for subsequent similar MILCON projects and reduces the effort of designing those facilities each time they are needed.

The Corps actively supports the Department of the Army (DA) Facilities Standardization Program; has primary responsibility for developing, implementing, and maintaining design standards; and has a supporting responsibility for selecting which facility types to standardize. Recently, the cost-effectiveness and objectives of this program have been questioned: Do standardized facility designs save the Army money and/or provide other benefits? If so, are those cost savings and/or other benefits realized during planning, programming, design, construction or during the operation and maintenance of the facility? In this report, we answer those questions.



## The Facility Design Process

The end product of the facility design process is a set of detailed construction drawings<sup>1</sup> and construction specifications.<sup>2</sup> During the design process, the building's owners communicate their needs to an architect who develops the design through a series of progressively detailed stages that determine what the facility will look like and how it will function. In developing the design, the architect considers many factors — the purpose of the facility; the owner's objectives; the construction budget; the quality (or image) the building will portray; and the site characteristic, geographical (environmental) condition, and building code (private-sector)/design criteria (public-sector) of the locale in which the facility will be built. The design documents ensure that communication between the owners and architects is precise and that the physical construction of the facility conforms with the owner's objectives.

## Design Standardization

The normal design process requires many decisions about what functions a building is to serve and how it should be constructed to best serve those functions. Under certain circumstances, any number of those design decisions can be made in advance — that is, they can be *standardized*. Design standardization of facilities is a process that ensures that successful designs and/or elements of a design are repeated for succeeding construction of similar facility types. It ensures that the best or most cost-effective aspects of a particular design are incorporated because when design decisions are to be standardized, they must be made carefully and life-cycle costs must be considered. Since standardized design decisions account for many of the design's functional requirements and most of its conceptual development, design standardization can shorten those aspects of the design process on any subsequent construction of that facility type.

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<sup>1</sup>Construction drawings, often referred to as blueprints, graphically illustrate a detailed visual image that the intended building should satisfy. The drawings communicate the shape and size of the building, the building components, and the way those components will be assembled or constructed. The set of construction drawings also includes schedules that illustrate building materials, equipment, and/or manufactured products that will be used.

<sup>2</sup>Construction specifications, which are usually typed and bound, describe construction processes to be used (or avoided), performance levels that building components must satisfy, and suggested or mandatory construction and finish materials. They may, in fact, identify specific manufactured products that are to be used in the building.

Design standardization does not imply that all facilities constructed from a standard design will look alike. The design decisions that determine the form, shape, and image of a building may not necessarily be the aspects that are standardized. In fact, design standardization can take many forms but can be categorized into four levels on the basis of the degree of standardization achieved:

- *Standard Design Criteria (Level 1).* Design criteria provide the lowest level of design standardization and usually consist of written and/or graphic guidance that describes general standards and requirements necessary to meet such established conditions as space allocations and proximities, required materials and finishes, equipment selections, etc.
- *Standard Functional Modules (Level 2).* Functional modules are graphic (usually single-line drawings) and written descriptions that detail specific activities within a facility, such as types of offices, utility rooms, storage rooms, dormitory rooms, etc.
- *Definitive Drawings (Level 3).* Definitive drawings (either single-line or double-line) provide an even higher degree of design standardization. While they show building elevations, space allocations and proximities, floor plans, special features, and requirements configurations for a complete facility type, definitive drawings only serve as a guide for developing detailed designs. A definitive drawing set may include a number of standard options (such as exterior finishes, interior finishes, utilities, etc.) that make implementation of the design much more flexible. Definitive drawings can vary significantly in their stages of design development, but they typically represent at least the conceptual development stage of a normal design process. Therefore, definitive designs are not prepared in sufficient detail to be used as a construction drawing set. Definitive drawings are sometimes thought of as prototype designs.
- *Standard Designs (Level 4).* Standard designs provide the greatest degree of standardization and are often thought to be totally "complete designs." They show the same information as definitive drawings but include construction specifications and enough material, equipment, and assembly detail to use them as construction drawings. However, because of the variability of site conditions, standard designs normally have to be adapted to conform to the unique characteristics of each site.

To support a design standardization program, the managing agent must perform additional procedures that are not required for traditional design program management. Depending on the individual design agencies' procedures and the level of standardization they choose, additional resources may or may not be required. The procedures for design standardization programs can be categorized as follows:

- *Selecting* the facility types for standardizing and the appropriate level at which to maintain them. Typically, the facility types must have a repetitive requirement and must be capable of consistent operation from one site to the next.
- *Developing* the standard design packages to the level at which the desired design decisions are standardized.
- *Implementing* the design standards for each new facility by incorporating them into the facility acquisition process and enforcing the use of the standards for the appropriate facility types.
- *Maintaining* the design standards by monitoring their effectiveness, providing feedback to the appropriate office, modifying/updating them as needed, and disseminating any changes.

The motivations to use standard designs are many and varied. One reason to standardize design decisions may be to ensure that similar but distinct facilities all function the same, provide the same quality environment, and have similar lifetimes or rates of deterioration. Sometimes the image a building portrays to the public is important to standardize. In other cases, the important goal is to standardize the maintenance and/or operations of a facility type by ensuring that each succeeding facility has the same mechanical equipment, for example. Other objectives can include reducing construction costs and/or time subject to quality constraints and reducing the costs and/or time for designing subsequent buildings so that the buildings can be opened and occupied as soon as practical and begin to serve their intended purposes. In any case, whenever a design decision results in higher overall building performance or lower life-cycle costs, standardization should be considered.

Some misconceptions about design standardization costs, however, can at times lead to bad decisions.<sup>3</sup> One notion is that reducing design costs is an easy way to save money when constructing a facility. In reality, the design phase provides the greatest opportunity to identify constructability and maintainability issues that can ultimately reduce construction and operations and maintenance (O&M) costs. A second misconception is that reducing design costs significantly affects a facility's life-cycle costs. Actually, design accounts for less than 2 percent of the facility's life-cycle costs, with the remainder being associated with construction and O&M.

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<sup>3</sup>LMI Report ML518, *Better Facilities Through Design Standardization*, William B. Moore and John H. Cable, March 1986.

## **STUDY APPROACH**

The Corps of Engineers tasked the Logistics Management Institute (LMI) to examine the effectiveness of the DA Facilities Standardization Program. This report presents the results of our investigation of design standardization programs in the private sector and other Government agencies and addresses the following pertinent issues as compared to USACE's program: the organizational structure that supports of design standardization; the programs' objectives; the procedures and costs to select, develop, implement, and maintain design standards; the tangible and intangible benefits the programs provide; the internal and external constraints that affect or impede the programs; and the programs' future outlooks.

We interviewed key USACE personnel (at headquarters and the operating districts) and gathered information from engineering handbooks and Army regulations and pamphlets to gain a full understanding of the DA Facilities Standardization Program, which serves as the baseline for the study. From that information, we were able to formulate our interviews with the private-sector companies and other Government agencies.

At the same time, we identified private-sector companies and public-sector agencies that have legitimate design standardization programs. We focused on those organizations that standardized facility types similar to those of the Army's, had a high degree of standardization experience, and had adopted the definitive design (Level 3) and/or standard designs (Level 4). We then interviewed more than a dozen private-sector corporations and six public-sector institutions that met those requirements to determine how their design standardization programs compared with the DA's program.

## **REPORT ORGANIZATION**

The rest of this report is organized in much the same way that we approached the study. Chapter 2 focuses on the pertinent issues we learned from the DA Facilities Standardization Program. Chapter 3 provides a parallel assessment of private-sector and public-sector design standardization programs based on our interviews with them. Chapter 4 discusses the similarities and differences between USACE's program and the other programs we examined and provides our conclusions and recommendations for improving on USACE's program. Appendix A provides an alphabetical listing together with points of contact for the private-sector companies

and Government agencies we interviewed. Appendix B summarizes the private-sector companies' design standardization programs, and Appendix C provides the same information for the other public-sector organizations.

## CHAPTER 2

### DEPARTMENT OF THE ARMY FACILITIES STANDARDIZATION PROGRAM

#### BACKGROUND

Since World War II, the Army has standardized such highly repetitive facility types as barracks, child care development centers, and tactical vehicle maintenance shops. In the past, improper standardization objectives and procedures as well as inadequate staffing and funding prevented USACE from standardizing other facility types. However, in 1985, under the direction of the Vice Chief of Staff of the Army (VCSA), the Army established the DA Facilities Standardization Program, gave it sufficient resources, and directed USACE to generate an initial set of standard designs. At that time, the VCSA stated that "the Army cannot afford the luxury, nor are there justifiable reasons, to design and construct many unique facilities for each Army installation." The VCSA also emphasized the importance of Army-wide participation and directed that facility types should be standardized to the maximum extent practical.

To date, USACE has standardized 23 facility types<sup>1</sup> and plans call for increasing that number as the program expands. Although 3 facility types are maintained as standard designs (Level 4), the majority are maintained at the definitive drawing level (Level 3), which is the level recommended by USACE proponents. Beyond that level, maintenance of standard designs has proved to be cost-prohibitive.

#### OBJECTIVES

At its inception, the DA Facilities Standardization Program was justified on the grounds that it would improve facility quality and design excellence, increase customer satisfaction by providing consistent facility functional requirements, simplify facility programming, improve facility planning, ensure design consistency

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<sup>1</sup>A comprehensive list of standardized facility types can be found in U.S. Army Corps of Engineers Engineering Pamphlet (EP) 1110-345-2, *Index of Design Drawings for Military Construction*.

within an installation and among the major Army commands (MACOMs), lower design costs and time, lower construction costs and time, improve maintenance activities, and increase credibility with Congress as it relates to the MILCON programming.

The program seeks Armywide implementation of standard designs but recognizes that operational requirements may vary among some Army units, that geographic differences exist for construction material availability and construction labor expertise, and that site conditions (temperature, soils, etc.) vary. Where such factors make it impossible to implement standard designs, deviations from the standards may be granted or standard designs will be developed for a particular geographical area.

Although the program has not changed its objectives since its inception, it now appears to be focusing on improved and consistent facility operational requirements and reduced life-cycle facility costs. We found that the program's objectives are fairly well institutionalized at USACE headquarters but not well embraced by the operating districts. There, the program is such a small part of the overall design program that little emphasis is placed on realizing the potential benefits of standardization. As the DA Facilities Standardization Program moves into its seventh year, it will emphasize the collection of quantitative data to determine whether it is meeting its intended objectives.

#### **SUPPORTING ORGANIZATIONAL STRUCTURE**

A cadre of part-time Army and USACE personnel from a number of different organizations support the DA Facilities Standardization Program although USACE plays the most active role. The Chief of Engineers was given primary program responsibility, but the overall program management and authority rest essentially with five different groups (discussed in greater detail in the following paragraphs): the Architectural and Planning Branch (referred to as CEMP-EA throughout this report) of the USACE Engineering Division, the DA Facilities Standardization Committee, the USACE Subcommittee, specific facility-type subcommittees, and the Centers of Standardization (COSs). These groups meet on an as-needed basis to manage the program and resolve conflicts. This process of full participation by both functional and technical proponents ensures consistency among the MACOMs and creates an environment for developing productive and quality designs with a sense of

ownership and acceptance. Because the program does not have a dedicated staff and the part-time committee support is not charged against the standardization projects, it is difficult to calculate a staff-equivalent level of support for the program.

### **Architectural and Planning Branch**

Within USACE, the CEMP-EA is responsible for providing design guidance for all Army facility types including standard designs and for coordinating all requests for MILCON funding (using the DD Form 1391 process). As a result, the CEMP-EA has the initial responsibility for ensuring compliance with the DA Facilities Standardization Program, at the Army HQ level. The CEMP-EA has adopted a *special design instructions* form that mandates use of standard designs when appropriate and communicates that information to the executing USACE District.

The CEMP-EA devotes approximately 5 full-time-equivalent staff out of its total staff of 13 to the standardization program activities. Each member of the CEMP-EA is responsible for approximately 50 to 60 facility types, which may include one to three standard designs. The CEMP-EA believes the design standardization program simplifies the facility acquisition process and requires less net staff than would otherwise be necessary if no standardization program were in place.

### **Department of the Army Facilities Standardization Committee**

The DA Facilities Standardization Committee has overall program responsibility and authority. The committee is chaired by the USACE Director of Engineering and Construction and consists of 26 voting members who are drawn from DA Staff offices, the USACE, and each MACOM. All facility types recommended for standardization and all final standardized definitive designs must be approved by the committee. Its diverse make-up ensures widespread support for the decisions it makes.

### **USACE Subcommittee**

As the Army's design agent, the USACE Subcommittee is responsible for coordinating the development of the standard designs, for ensuring compliance with the program at the District level, and for selecting the USACE District or Division as the design proponent for a particular standard facility (see the ensuing subsection on "Centers of Standardization"). Headquarters USACE selects the subcommittee



chairman from one of the active members, and one representative from each USACE Division having military construction responsibility sits on the subcommittee.

### **Facility-Type Subcommittee**

Once a facility type is selected for standardization, the Corps forms a subcommittee of operational and functional proponents of that particular facility type. Each standardized facility type has an acting subcommittee to ensure that the standard designs satisfy the functional and operational requirements intended for that facility on an Army-wide basis and to serve as the first line of approval for the development of the standard design. The subcommittee also ensures the standard design is regularly updated and satisfies the user's needs on an ongoing basis. The subcommittee receives technical support from the appropriate COSs.

### **Centers of Standardization**

Twelve COSs have been established at Corps Districts and Divisions<sup>2</sup> to help support the DA Facilities Standardization Program. Their primary responsibilities include developing and maintaining standard design packages for which they are direct-funded. They develop those packages either with in-house staff or by using architect/engineer (A/E) contractors. A given COS may be in charge of only one or many standard designs. The COSs evaluate the technical sufficiency of standard designs through design, construction, and operations; evaluate the operational effectiveness of the standard designs; maintain and update the standard design packages as required; monitor their use; provide technical support (as needed) to other agencies implementing the standard design; participate in Post Completion and Design Criteria Feedback Inspections (DCFIs); and maintain a current file of completed projects based on the standard designs.

## **PROCEDURES**

### **Selecting Facility Types for Standardization**

The Army's real-property inventory contains more than 600 free-standing facility types with the potential to be standardized. However, the outyear MILCON program contains only a fraction of those facility types. Even though USACE has

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<sup>2</sup>A complete list of the COSs together with their current standardization assignments can be found in U. S. Army Corps of Engineers Engineering Regulation (ER) 1110-3-109, *Corps-Wide Centers of Expertise Assigned to Divisions and Districts*, 31 July 1990.

developed only 23 standard facility designs, those designs account for 19 to 27 percent of all new designs (based on the projected 1992 to 1997 MILCON program). That percentage should not come as a surprise since one of USACE's objectives for selecting a standard facility type is that at least 10 projects using that facility type be planned within the succeeding 5 years.

Candidate facility types are selected in several ways:

- The CEMP-EA can recommend a particular facility type based on the number of expected projects in the outyear MILCON program. The CEMP-EA takes an informal process and cost-benefit approach that compares the projected standard's anticipated development and maintenance level of effort against the anticipated savings.
- Any subcommittee can recommend a facility type based on functional or operational considerations and on projected new facilities planned beyond those programmed in the Five-Year Defense Program.
- The DA Committee can recommend a facility type as a matter of policy. The DA Facilities Standardization Committee votes on the recommendations based on input from the subcommittees and the CEMP-EA.

Part of the initial cost-benefit discussions conducted by the CEMP-EA include some attention to the most cost-effective level at which to standardize the design. Alternatives include criteria and specifications only, modular design, definitive-level design, or 100 percent standard designs. During this process, the CEMP-EA determines the aspects of the design that will be standardized and those that will be optional. The final decisions rest with the Facility-Type Subcommittee. Although these decision rules are well understood within the CEMP-EA, no process structure exists and the rules have not been formalized in writing.

### **Standard Design Development**

The USACE Subcommittee assigns approved facility types to a COS, which then becomes responsible for development of the standard design. The Facility-Type Subcommittee ensures the standard design meets the operational and functional requirements of the users, while the COS ensures the design meets technical standards.

In the past, standard designs have been taken to 100 percent (Level 4) design completion, but USACE found that at that level, the designs became too difficult to maintain. Now, USACE promotes development of the standards to the definitive

drawing level (Level 3) – about 10 to 15 percent design completion. Each definitive design package is developed for a generic site with standard options that satisfy as many of the anticipated geographical and site variations as practical. USACE standard designs do not need to consider local building codes since all Army installations are governed by the Uniform Building Code. When the standard designs are being developed, they undergo complete value engineering and constructability evaluations.

Depending on its existing workload, the COS may choose to develop the standard design package inhouse or to contract with an outside A/E firm for its development. If a contractor is used, the COS is responsible for design review and contract administration. Either way, each standard design receives funding from USACE for its development.

Fully developed standard design packages must be reviewed by the Facility-Type Subcommittee for user responsiveness and maintainability, by the USACE Subcommittee for Technical Compliance, and by Technical Centers of Expertise (if required). Finally the DA Facilities Standardization Committee must approve them. Each step in the review process may result in design changes, and those changes must be incorporated before proceeding to the next step in the process. The review helps to ensure that the standard designs are the "best" for all practical purposes. Once approved, the selected facility type becomes the new Army standard and is mandatory for all subsequent projects using that facility type. The standard design packages are stored at the USACE Huntsville Division as reproducible hard copy and, for more recent standards, as electronic computer-aided design and drafting (CADD) files.

### **Implementation of Standard Designs**

The implementation of standard designs differs slightly from that of unique designs. If standard designs are available, their use is mandatory and unjustifiable deviations are not permitted. Even with standard designs, the process still begins with an installation's request for MILCON funding through the DD Form 1391, *FY Military Construction Project Data*, process; if the needed facility is one of the 23 standard designs, the installation must note that fact on the DD Form 1391. The succeeding MACOM review should catch any oversights. Like normal design, approved projects using standard designs are then submitted to the Assistant Chief of

Engineers for a DA-level review by the Construction Requirements Review Committee for inclusion in the MILCON program and by the CEMP-EA for its technical concurrence. Normal and standard design projects passing these requirements are then cleared for design development. Projects that come under the Facilities Standardization Program do not impose any additional procedures on this system. In fact, because the standard designs have been developed in advance, planning and programming for these projects is simplified.

The CEMP-EA then submits the architectural and engineering instructions and the special design instructions form for standard designs to the acting USACE District responsible for the project's conceptual development. Since standard packages have already been developed, the District need only request the standard design package from the USACE Huntsville Division and use it to the maximum extent possible in completing the conceptual design and generating a current working cost estimate. The standard design package includes the definitive level drawings (between 10 and 20 sheets), applicable design specifications, and a lessons-learned report generated from previous implementations. An HQUSACE design directive requires coordination with the COS to ensure that lessons learned, the standard's cost, and regional application are tracked. The implementing District sometimes has difficulty enforcing the use of standard designs on those users who prefer unique designs to satisfy their facility requirements.

When Congress approves projects for final design and construction, those final designs are completed by the responsible District. Projects using unique designs and projects using standard designs are managed identically in most USACE Districts. The designs may be completed by the District's in-house staff or by contract with an outside A/E firm. If designed under contract, then the supporting USACE District is responsible for design review and contract administration. The District may request support from the standard's COS on an as-needed basis, but because of the additional coordination required, the Districts can expend as much effort implementing a standard design package as they do in implementing unique designs. However, this process ensures quality designs are developed, thus avoiding costly change orders.

Once an installation implements a standard design, that particular design with its chosen standard options becomes the exact standard for all future implementations of that facility type for that installation.

Sometimes the USACE Districts decide to use an outside A/E firm to complete a standard design. The Brooks Act precludes the selection of an A/E firm on the basis of cost alone. To ensure that the Government benefits from the standardization experience of A/E firms, some Districts have included familiarity with the design in the selection criteria. Those Districts have found that when an A/E firm has completed a design using a standard design package, its subsequent design fees are 30 to 40 percent less. The lower design fee is attributed to the fact that the A/E firm has already verified the design during the first effort – assuming the liability for the design – and merely needs to adapt the succeeding designs to the sites.

To eliminate the additional costs imposed by A/E firms who are unfamiliar with a standard design, special design instructions completed by CEMP-EA "strongly recommend" in-house design where standardized designs are being used. Because A/E firms are ultimately liable for the finished product, they must charge USACE to verify the design work already accomplished in developing the standard design. Because of limits on in-house design efforts, not all standards can be completed in house and the instructions to design in house cannot be made "mandatory."

### **Maintenance of Design Standards**

In the DA Facilities Standardization Program, the standard designs are constantly evolving and additional manpower is needed to evaluate the changes and make the corrections to the standard design packages. USACE has implemented active feedback programs through the DCFIs and user involvement. Each COS is responsible for ensuring that constructability and maintainability feedback is evaluated in terms of life-cycle cost effects and that changes to the standard design are made as appropriate. Changes to a standard must be approved by the appropriate Facility-Type Subcommittee and the DA Facilities Standardization Committee. The updated standard design packages are retained at the USACE Huntsville Division and kept current for ensuing implementations of the standard design.

### **BENEFITS**

Recent analysis conducted internally by HQUSACE suggests that projects using standard designs have already realized some intended benefits. Subjectively, it appears as though the program is satisfying all its quality, consistency, and operational objectives. Also, preliminary results of that analysis indicate that, on average, projects utilizing standard design reduce design costs, construction cost

growth, and construction time growth. However, the quantitative analysis is still incomplete and is based on less than 50 completed projects. To verify some of these claims, we also evaluated design costs, construction cost growth, and construction time growth of standard facilities and compared that information to all other MILCON projects. We used data from the Corp's Automated Management and Progress Reporting System (AMPRS). Since only 47 projects have been completed using standard designs (and some of those projects contain incomplete data), statistical analysis proved inconclusive. While individual project data showed that some projects using standard designs reduced design fees, other standard projects did not. As the program enters its second phase, the COSs will begin to track quantitative program information so that internal evaluation of the program will improve. Additionally, more quantitative data will become available as projects using the standard designs are completed.

#### **FUTURE OUTLOOK**

Currently, the Army does not plan to make any major changes to its standardization program. However, the proliferation of CADD in the USACE will change the way USACE Districts transmit and store the design standards. Since changes will be easier to make with CADD design, the standards can be maintained at the 60 to 90 percent complete level. The use of CADD will also facilitate transmission of the standard design from the COS to the central repository at the USACE Huntsville Division and again from there to the implementing District. As designs are implemented, 100 percent designs can be stored and reused as appropriate for a given geographic area and site conditions. Future implementation of that design will require less design effort, and CADD will simplify the maintenance of the standard design. The Corps' goal is to have a standard design, developed on CADD, for each geographic region that potentially requires a standard package.

## **CHAPTER 3**

### **DESIGN STANDARDIZATION PROGRAMS FROM OTHER ORGANIZATIONS**

We interviewed more than a dozen private-sector companies and six public-sector agencies to learn why they standardize designs and how successful they are in doing so. Appendix A lists the private-sector companies and Government agencies we interviewed together with the points of contact. We concentrated our interviews on only those organizations that have active design standardization programs, use standardized building designs that are similar to one of the Army facilities that is standardized, operate over a large geographic area (usually nationwide), and use at least the definitive design level (Level 3) of standardization. Appendix B presents profiles of the private-sector companies interviewed and summarizes their design standardization programs and Appendix C describes design standardization programs in other Government agencies.

We discovered considerable variation in the size of the design standardization programs we evaluated (programs varied from 0 to 400 new standard design sites per year), the way they are managed, the methods of standardization, the organization that manages them, the company objectives for implementing them, and the benefits they enjoy as the result of implementing the programs. However, in every case, the design standardization programs are centrally managed and are fully supported by senior management. This chapter parallels the findings from the DA Facilities Standardization Program, and summarizes each of the major issues from the private- and public-sector organizations we interviewed.

#### **OBJECTIVES**

None of the private-sector companies we interviewed has well-documented objectives for their design standardization programs. Yet, most companies believe the justification for standardization to be intuitively obvious. Private-sector companies are in business to make a profit. Their primary objective for standardizing facilities is to further that goal. To achieve that goal, most of the companies we interviewed focus on generating higher revenues (as opposed to reducing costs) by

improving productivity of their facilities. That approach is not surprising since they recognize that in the first year of operation many facilities can generate revenues that are five to six times greater than the cost to design and build them. The real money is not in avoiding the costs to design, construct, and maintain facilities but rather in the function that goes on inside the facility. Private-sector companies have learned that lesson well. However, most of the companies also recognize that standardization offers them opportunities to reduce facility life-cycle costs, and they do not ignore such opportunities.

Similarly, in the public-sector, design standardization focuses on consistent appearance and quality, maximizing functional productivity and reducing the time to plan, program, design and construct facilities. However, like their private sector counterparts, some public-sector agencies take advantage of the opportunity to reduce some aspect of life-cycle costs when practical. Public-sector agencies feel they have more difficulty achieving design and construction cost savings than do the private-sector companies because of contracting restrictions.

### **Productivity Enhancement Objectives**

Most private-sector managers we interviewed agreed that facilities can best contribute to a company's bottom line by improving the company's operational productivity, increasing its ability to attract business by presenting a consistent visual image (analogous to brand recognition), and requiring minimal time for design and construction so that they are put into service sooner.

In most companies, personnel we interviewed expected their buildings to be highly productive and efficient — both in terms of business operations and building performance. The standard building designs for fast food operations, auto service stations, merchandising, and child care facilities reflect the importance of functional relationships between building form and layout and the delivery of services or products. For some, consistency in layout and function ensures that users will be familiar with facilities from one location to the next. For most companies, a standard building design is one element in a bigger picture of efficient, standard operating procedures based on years of experience and internal analysis.

Nearly all the companies we interviewed standardize all or some aspects of the facility's form and appearance to communicate a consistent image to the public. A consistent appearance guarantees instant recognition and serves the company's



marketing objectives. Most companies insist on quality construction and materials to further portray a certain image to the public. For others, in such markets as the automobile industry, major market research efforts result in standardization of floor plans for showrooms and service centers to provide a unique experience to the prospective car buyer.

For the private sector, design standardization also means that a facility can be designed and constructed quicker, occupied sooner, and begin to generate revenues quicker. Several companies and the one university we interviewed explained that one of their objectives for design standardization is to deliver facilities 6 to 12 months sooner than they could with nonstandardized designs.

Although public-sector agencies are not under the same pressures to generate revenues, their productivity enhancement objectives are similar. The need to construct facilities nationwide that are consistent in quality, image, and functional productivity is a fundamental objective of the construction programs of many of those we interviewed. Simplification of design and the reduction of the time required for planning, programming, and designing are essential elements of a well-managed facility acquisition program. By reducing the time needed to acquire new facilities, these organizations found they can accomplish more work with the same internal staff levels and occupy the building sooner. For example, the U.S. Postal Service (USPS) maintains that the underlying objective of its program is to reduce the time needed to plan and design between 400 to 700 new facilities a year. Without design standardization, the current in-house manpower would be insufficient for those tasks.

### **Cost Reduction Objectives**

Each private-sector company we interviewed recognizes the opportunity to save costs on the design, construction, and building O&M; however, these concerns are almost secondary to enhancing the facility's operational capabilities discussed in the preceding section. Nonetheless, facility design and construction is expensive and the cost savings are still attacked aggressively. The public-sector agencies are much less aggressive in attempting to reduce such costs. Instead, the justification for their programs relies more heavily on other, noncost objectives. Where cost savings can be easily achieved, these companies take the necessary actions to do so.

Private-sector companies expect to reduce design costs. First, standardizing designs means that much of the facility's functional requirements and building form are established before architects begin to develop conceptual alternatives; that procedure results in less work during the conceptual development phase and, therefore, in theory, generates lower design fees. Second, the repetitive nature of standard facility types means that private-sector companies can establish a continuing relationship with an architect and that subsequent implementations of a particular facility type can result in lower fees since the architect has already verified those aspects of the design that are standardized. Although not a primary objective, the USPS expects its "kit-of-parts" (see Appendix C) program to produce similar savings on contracted A/E design fees.

Both private- and public-sector agencies expect to control facility construction and O&M since a feedback mechanism of lessons learned in terms of constructability and maintainability from previous implementations can be applied to all succeeding facilities. By learning from the mistakes and successes of past designs and applying that experience to generate improved design elements (in both drawings and construction specifications), organizations can build facilities that meet all the operational, image, and quality objectives at lower costs for construction, operation, and maintenance. At least one private-sector company we interviewed insisted that lower construction costs are never allowed to compromise a facility's image, quality, or capability to operate more productively or efficiently. Several organizations perform life-cycle cost analyses on all standardized design decisions and all changes to them. Generally, they can secure the lowest possible construction costs because they know the costs to construct the facility and can control them.

An overall objective expressed by nearly all the private-sector companies we interviewed can be stated as follows: *to deliver the most operationally productive and cost-effective facility to the users in order to ensure the highest profitability for a given sales volume.* The same overall objective for Government agencies can be stated as follows: *to reduce the time to deliver highly productive facilities with consistent quality and appearance.*

## **SUPPORTING ORGANIZATIONAL STRUCTURE**

Without exception, all the organizations we interviewed supported design standardization programs through a design, architecture, planning, or construction

department within their headquarters. This centralization of authority reflects a widespread recognition of the importance of design standardization programs and their impact on the organization's objectives.

However, not all organizations executed the standard facility projects centrally. Several private-sector companies and most of the Government agencies have established regional offices with decentralized design and construction departments that are responsible for local coordination with the owners (users), outside A/E firms, and construction contractors. The degree of discretion assumed by field executives for deviating from the standards varies. As a result, the standardized elements of the designs does not always survive the local coordination although the headquarter elements are fully responsible for review and approval of the final designs. Other organizations are more authoritative and allowed few deviations from the standard designs, particularly those elements of the standard that deal with operational efficiency, quality, and visual image cues.

### **Staff Sizes**

None of the organizations we interviewed supported their design standardization programs with large headquarters staffs. The staffing varied from a low of 1 to 2 persons to a high of 15, with varying standard design and construction responsibilities. Typically, committees consisting of members from operational elements, design departments, and upper management are formed to develop, review, and approve standard designs and to change standard elements of existing standard designs.

Because of the diversity in each of the organizations and their design standardization programs, we cannot correlate the staff size directly with the nominal volume of design or construction activity involved. This lack of correlation is attributable to one or more of the following conditions, which apply to all organizations:

- Levels of design standardization vary, and that variance affects the amount of design work required.
- Some organizations contract for the preparation of construction drawings and others do not.
- Some headquarters staff supervise construction and others do not.

- Some headquarters staff members are responsible for maintaining the design integrity for existing facilities as well as designing new ones.
- Some organizations stopped construction in response to the 1990-1991 economic downturn but retained staff for future growth plans.
- Some organizations relied heavily on CADD, which reduced staff requirements.

## **PROCEDURES**

### **Facility Selection**

For most of the organizations we interviewed, the question of why they selected standardized designs for certain building types was easily answered: they were responsible for only one facility type, that facility was repeatable at a number of geographically separate locations, and it was cost-effective for the company to standardize that particular design. Only the Naval Facilities Engineering Command (NAVFAC), the Army and Air Force Exchange Systems (AAFES), and one of the private-sector companies we interviewed maintain several standardized designs corresponding to the different types of facilities that they develop and operate. Some of the other organizations did, however, maintain various sizes of the same facility type.

### **Standard Design Development**

Nearly all the organizations we interviewed maintain their standard designs at the definitive drawing level (Level 3) together with established design and construction specifications. Although definitions varied, the definitive design packages were considered between 10 and 50 percent design-complete. Some companies, such as auto rental companies and motel companies, also rely on highly developed functional modules as part of their design specifications for those building areas that are either highly mechanical or constitute the core of the business.

The NAVFAC has developed or is in the process of developing standard designs on several levels including modular designs, definitive-level standard designs, 35 percent and 100 percent kit-of-parts, automated site adaptations, and fully developed standard designs. NAVFAC examines the future worth of the facility and the complexity of design to determine the appropriate level at which to standardize a particular facility type.

Because of the high visibility, desired flexibility, and high dollar volume of standard facilities constructed every year, the U.S. Postal Service develops its standard designs and implements them through a kit-of-parts (Kit) program. The Kit is comprised of CADD-generated specifications and drawings for basic functional modules (six for the USPS) that will create a full set of 100 percent design-complete documents for the facility. The set of drawings does not include site-specific design features. Outside A/E firms are hired to develop the actual designs and adapt them to various sites using the Kit. The Kit combines the adaptability of custom design with the advantages of standard designs. The USPS spends more than \$2 million to develop a facility with the Kit; however, for those facility types that do not require that same level of development, the USPS has also developed a definitive level Kit that requires a design development investment of only about \$300,000.

Several private-sector companies maintain their standard designs at a higher level but not quite at 100 percent construction drawings (Level 4). In such cases, the companies utilize CADD to store previous designs of the standard facility and use those designs as the starting point for subsequent ones. Thus, the standard designs in those companies really constitute an historical file of all previous designs. Other companies that now maintain their standards at the definitive level had, in the past, maintained them at a higher level but found that at that higher level they are less flexible and more costly to maintain.

We found that most organizations develop their standard designs in-house but seek outside A/E assistance when in-house efforts are not adequate. When possible, new standard designs are based on current ones. Most organizations do not want to "reinvent the wheel" and find that successful standard designs and/or aspects of standard designs can be adapted to satisfy the new operational objectives.

For a few of the private-sector companies and two public-sector organizations, the USPS and AAFES, new business objectives (or new product lines) stimulated innovative facility designs based on extensive research that determined successful image, colors, quality, and material selections. In most cases, productivity enhancements to the facility's operational functions are the direct result of efforts of the organizations industrial engineering or similar departments.

Most organizations approach the development of new standard designs by utilizing key personnel from operations, marketing (private sector and AAFES), and

finance as well as the designers, architects, engineers, and perhaps even contractors. This team approach is used to review all current designs, inspect existing facilities, closely examine the designs of competitors, and, in some cases, conduct primary research. Studies may be commissioned for specific functional areas of buildings. Frequently, materials or equipment may be tested in a few sites. In the end, prototypes are developed and submitted to senior management or to a committee for its approval and adoption as the new standard. New definitive drawing level (Level 3) standard designs can take up to 1 year to develop.

The approaches that organizations we interviewed took to develop a standard design reflect their motivation, their sense of where the opportunities lie, and their current organizational structure and history. Not surprisingly, the actual levels of effort they expend to develop a standardization program vary widely although the interviews provided a few standard guidelines on costs. For those organizations that had merely modified existing standard designs, the cost to develop a new standard design package was about two or three times that of a unique design and represents the least costly effort. At the other extreme, when new standard facilities were designed from scratch, the organizations did not hesitate to undertake massive marketing research and design development costing millions of dollars to ensure a fully functional and cost-effective facility. For example, two companies we interviewed conducted multimillion dollar marketing research studies to re-examine all aspects of their facility design. They incorporated those marketing results into construction specifications for material types, functional layouts of the facility, and distinctive visual cues that resulted in company recognition.

### **Implementation of Standard Designs**

Most organizations we interviewed control the actual *implementation*<sup>1</sup> of standard designs either centrally or through regional offices. While centralized execution ensured total compliance with the standards and program objectives, it was not always possible or practical. In cases in which centralized execution was not possible, regional offices were given implementation authority although headquarters retained an oversight function.

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<sup>1</sup> By "implementation," we mean the effort required to produce a full set of construction documentation for a new facility construction project starting with the standard designs.

When implementation was managed centrally, the definitive drawings were adapted to the site by in-house staff or by a locally contracted A/E firm. When local A/Es are hired, they are provided the standard designs together with the specifications to ensure they fully understand the organization's functional requirements. The entire design process is controlled by the headquarters staff, and that staff can ensure conformance to the standards. We found that most private-sector and some public-sector organizations maintain lists of preferred A/E firms on a regional basis so that local knowledge of building codes, material availability, and construction expertise can be acquired. Other private-sector companies may retain a single A/E firm that is responsible for accumulating such local knowledge for each implementation. Except for the USPS, public-sector agencies tend to shy away from this strategy to avoid contracting competition problems.

When regional offices control the implementation of the standard designs, they also control the hiring of local A/Es. The headquarters staff provides the regional office with the most recent standard designs and decentralizes the development authority. The regional office then develops the site-specific design with a local A/E firm and business owners. As a result, even though headquarters usually retains final approval authority, deviations from the standards are permitted. Freedom from the standards may be granted as long as the deviations do not severely affect image, quality, or productivity standards. Often, the regional offices themselves may retain favorite A/E firms, which then become familiar with the particular design.

A couple of the private-sector companies we interviewed stated that their goals are to move the liability of the design to an outside A/E firm. As a result, very little detailed design is done in house, and an outside A/E firm is hired for each implementation of the standard facility.

### **Maintenance of Standard Designs**

Each organization reported that it had some level of effort under way to maintain its standard designs, to ensure currency and cost-effectiveness, and to continually improve the facility to satisfy the program's objectives. No private-sector or public-sector design standardization program we investigated was stagnant. Rather, active feedback programs continually examined operations, constructability, and maintainability to identify opportunities to change and improve the standards. In most cases, the companies conduct rudimentary life-cycle cost analysis to

determine the effect of a change on the facility's cost-effectiveness. One company mentioned that it could have designed out an additional \$20,000 in construction costs to avoid higher O&M costs but chose not to so that life-cycle costs would be lower. Other maintenance activities include testing prospective building materials and keeping abreast of and evaluating new product developments.

In both the private and public sectors, feedback programs may or may not be formalized. Most organizations send headquarters staff on periodic site inspections to learn how the facilities are performing. One private-sector company that has a formal plan selects every fourth or fifth completed project for a comprehensive review over a 2-day period by all staff involved in the project – design, management, marketing, operations, and construction. These meetings raise design, construction, and maintenance issues that are evaluated to determine whether the standardized design or elements of it should be modified. Other companies regularly schedule meetings to review performance of individual facilities. Some of the ideas generated at these meetings lead to standard design modifications. Public-sector agencies typically mandate post-construction design reviews and provide their results to the proponents of the standards for design updates. All updates usually require the same approval process as did the standard design development process.

One private-sector company feels so strongly about continual improvements to its standards that it hires an outside A/E firm every 3 to 4 years to audit the standard design package for constructability and maintainability improvements. The audit costs more than \$200,000.

Most of the organizations believe that the effort required to maintain standard designs are negligible compared with the benefits. At one company, for example, about 1.5 staff years of effort per year are involved in updating all four of the standard designs and standard specifications.

## **BENEFITS**

In general, the organizations we interviewed do not monitor the success or failure of their design standardization programs nor do they intend to. They feel that the programs are so advantageous to their operational objectives that no evaluation is needed. Because the positive impact on the organization's productivity and



life-cycle cost reduction is so intuitively obvious, they feel no need to spend the time, effort, and resources to determine how beneficial the programs are.

As a result, we collected little quantitative information on the most significant aspects of the programs' objectives — operational productivity, image, quality, and consistency. However, in general, most organizations we interviewed felt that the programs are easily satisfying those primary objectives. In the private sector, since the primary objective for developing standard facility designs is to ensure profitability, any such profitability measures also reflect how well a company is organized overall, managed, and operated. Too many variables are involved to assess the singular contribution of standard facility design. Perhaps the best measure of success for the standardization programs of the organizations we examined is the fact that they plan to continue their programs for the foreseeable future.

Although none of the organizations systematically quantified the success of their primary objectives, some quantitative evidence indicates that the programs reduced the life-cycle costs. Although the following information is not statistically derived, we present it as anecdotal evidence as understood by the organizations we interviewed.

Several private-sector companies documented 10 to 40 percent reduction in the cost of construction when standardized designs were used relative to a one-of-a-kind project. Their comparisons reveal the gains they have achieved over many years of fine tuning their standardized designs and reducing the design errors. In part, the reduced construction costs are attributable to developing more cost-effective solutions to the designs, using sole-source contracting for general construction (10 to 25 percent reductions were based on familiarity and guaranteed workload), and entering into national buying agreements (10 to 15 percent reduction on materials purchased in bulk). Supporting this finding, an architectural firm reported that it can reduce the construction costs of second and third repetitions of a standardized design by 10 to 20 percent, based on experience with the first project.

By utilizing national purchasing accounts for building materials and equipment for multiple sites, six of the companies we interviewed saved on the order of 10 to 15 percent of the original cost of building equipment or materials purchased. The effect of bulk purchasing on the total construction cost is typically a 2 to 4 percent savings for a project. Although AAFES also experienced similar success, the amount

it saved is not documented. In a similar vein, one company hired a general contractor to construct almost all of its buildings (about five per year). That contractor was able to achieve economies of scale in supervision, labor load leveling, and material purchasing that reduced construction costs of successful projects between 10 and 25 percent. None of the Government agencies award sole-source construction contracts for their standard designs.

Since the dominant objective is ensuring cost-effective and high-quality performance, a more direct benefit of design standardization is often a reduction in construction time, thereby assuring earlier delivery of the building and its promised performance. Most organizations experience this benefit to some degree. One company developed a standardized design for its housing facilities that involves a modular construction method with prefabricated modules. The approach saves 10 to 15 percent in construction costs but, more important, reduces construction time by 40 percent, thus allowing the facility to be open for "business" 8 to 10 months sooner.

Although reduced design cost and time are not the primary concern of standardization programs, most organizations felt they were able to reduce both. The most significant design savings are attributable to perceived A/E procurement advantages that private-sector companies enjoy. USPS also enjoyed design cost savings in large part, because it is not subject to the Federal Acquisition Regulation (FAR). For example, two private-sector companies and USPS experienced between 50 percent and 80 percent reductions in design fee (from 6 to 7 percent of construction costs to 1 to 3 percent of those costs) because they were able to establish an ongoing relationship with the same A/E firm or able to develop a short list of A/E firms. As a result of this relationship, the A/E firms assumed the liability of the standardized aspects of the definitive designs (or higher design levels) on the first project and only needed to adapt subsequent designs to the sites. The A/E firms realize that much less effort is required for subsequent implementations and that reduced effort is reflected in their design fees to the owners.

A second way some private-sector companies save on design costs is by negotiating lower fees with A/E firms. Since definitive designs and specifications eliminate the need for the A/E firms and owners to negotiate the facilities' forms and functional requirements, the conceptual design phase is nearly complete when the design process starts. One company we interviewed had already challenged this notion and surveyed more than 40 A/E firms to test the hypothesis. It found that A/E

firms would be willing, on average, to negotiate a 10 to 15 percent lower design fee over one-time designs if definitive designs and design specifications were prepared by the owners in advance.

Another distinct benefit of standardized designs is that they shorten the design time, and that, too, reduces total development time. Most frequently, a standardized design reduces or eliminates the time usually allocated to design development, which can be 6 months or more. Thus, standard design packages that minimize design development for a given project can reduce 6 to 7 percent design fees by 1 to 2 percentage points as well as reduce the design time by 1 to 3 months.

A secondary but consistently noted benefit of design standardization programs in all the organizations we interviewed is simplified planning and programming. In a sense, this benefit has been recognized and reported already in terms of reduced design and construction costs and time. But a design standardization program that incorporates both standardized designs and a standardized design process, as these organizations have developed, enhances the ability to respond quickly to new initiatives.

## **CONSTRAINTS AND IMPEDIMENTS**

As with Army and other public-sector standardization programs, private-sector programs have some limitations. Some of these restrictions are universal and apply to all attempts by any organization to standardize design. Others are very much the result of internal organization history, culture, and business philosophy. Although the organizations we interviewed experienced one or several of the types of constraints and impediments described in the following subsections, they nonetheless chose to overcome the problems and move forward with their programs.

### **Regional Differences**

Obstacles to standardized designs are regional differences in (1) architectural design styles, (2) availability of building materials, and (3) construction methods. Organizations that construct many facilities throughout the nation have developed several alternative designs or options to single designs to accommodate style differences. For many other organizations, exterior appearance is not addressed by their standard designs, and local preferences can be implemented with little problem. One company provides more or less standard, pre-engineered facilities throughout

the nation, and yet it offers minor changes to those standard designs to accommodate weather or seismic variations. Those changes present no serious problems. Most organizations have found that standard designs taken to the definitive level can easily be developed with generic design solutions that are not site-specific.

### **Compliance with Local Codes**

The diversity found among the building codes in different locations creates an obstacle to standard design programs, but most organizations did not express undue frustration with it. The zoning requirements for each site must be checked individually anyway, and an organization can verify building code compliance at the same time. Most of the private-sector companies either retain a short list of acceptable consultants for verifying code compliance in specific communities or they retain the expertise in house. Furthermore, some companies have refined their standard designs to be in compliance with most local building codes.

### **Centralized and Decentralized Control**

Most of the organizations that decentralized project design reported tension between local field executives and headquarters staff – certainly not an unknown phenomenon. Whereas field staff argue for deviations from the standard designs to accommodate their own preferences, headquarters staff argue that the deviations are not always appropriate and can be detrimental to the program's objectives. Many of the organizations attempt to defuse the tension by providing standard designs with regional variations to reflect climate and indigenous building materials and styles, or to allow local A/E firms to decide these issues within the guidelines.

The ability of an organization to resolve this tension between field and headquarters staff is important. If senior management does not strictly enforce standard design decisions, the variations among supposedly standard buildings can get out of hand and defeat the intended objectives of standardization. Although the variations from the standard may not be significant, they can make it difficult for the company to modify these sites later to accommodate new business initiatives that would require global standard changes.

### **FUTURE DIRECTIONS**

The clear and consistent response to the question about future plans for their standard design program was evolution, not revolution. Although organizations

reported varying success from a variety of perspectives, none expressed an intention to change its approach dramatically; each expects to continue to develop and refine its program. All of the organizations are structured similarly to support standard designs, and none report any expectations of dramatic shifts in their organization's enthusiasm for it.

One significant trend that surfaced was the increased adoption and proliferation of CADD. Several of the organizations reported a heavy reliance on CADD now, whereas others have not yet explored it. Most were familiar with it, however, and everyone expects to expand its use in the future.

The adoption of CADD is encouraging a revolution in the design process; the schematic design stage need not now produce simple definitive drawings. The experienced CADD user can retrieve designs of existing modules, functional areas, or highly detailed components from a library of previous designs to quickly formulate a schematic that contains much more detail than before. CADD is encouraging the adoption of standardized designs that are more detailed and also enabling the central headquarters design staff to modify existing standardized designs to satisfy new site requirements more readily.

## CHAPTER 4

### CONCLUSIONS AND RECOMMENDATIONS

Both private-sector and public-sector organizations standardize designs whenever particular facility types can be repeated, when it is necessary to ensure consistency among the facilities, and when it is cost-effective to copy designs or elements of a design. For similar reasons, USACE has implemented the DA Facilities Standardization Program.

Although private-sector companies and some Government agencies enjoy certain advantages over the DA Facilities Standardization Program in procuring the services of an A/E, general construction (GC) contractor, and construction materials, most other aspects of the design standardization programs compare favorably. The Army standardizes more facility types worldwide than do private sector companies or any other Government agency we examined, but based on our assessment, we feel that certain strategies from private-sector design standardization programs can successfully be implemented in the Army.

In general, we found that the DA Facilities Standardization Program is much more developed than other private- or public-sector programs we evaluated and is, overall, a beneficial program to USACE and the Army. In this chapter, we present conclusions based on comparisons of the DA Facilities Standardization Program with successful design standardization programs in the private sector and other public-sector agencies. From this analysis we recommend ways to improve the Army's standardization program even further.

#### CONCLUSIONS

##### Objectives

Private-sector companies standardize facility designs to improve bottom-line performance. In the competitive atmosphere of the private sector, facilities are one aspect of overall business that must perform well to ensure profitability for the company. The greatest impact facilities can have on a company's bottom line is to maximize a company's functional productivity and attract business. However, these

facilities have high life-cycle costs, and design standardization furnishes private-sector companies with the opportunity to lower design, construction, and O&M costs of their facilities. Although the total savings realized by reducing life-cycle costs is not as great when compared with the effects of increased revenues, those cost savings can realistically be achieved and therefore are not taken lightly by a company whose bottom line is profit.

Most public-sector agencies focus on ensuring consistent quality and appearance across a nationwide base and maximizing facility productivity because of the high value of the physical facilities and the operations that occur within them. Some agencies seize the opportunity to reduce design and construction costs, too, but the justification for the program usually rests with objectives other than cost. Even though some public-sector organizations believe the FAR constrains any efforts to reduce design and construction costs, they still take every opportunity to save on costs when practical.

Given the high cost of manpower and the other costs associated with a facility's mission, the USACE needs to recognize the same long-term objectives for design standardization that the private sector and some other Government agencies do. Above all else, the Army must ensure maximum operational productivity of its facilities; reduce the time to plan, program, design, and construct facilities; and ensure consistent quality among installations. These objectives must continue to be the primary thrust of any design standardization program and must serve as its justification; at the same time, however, USACE must take advantage of every opportunity to reduce the life-cycle costs of facilities. It must do so by cost-effective construction, reduced facility design costs, and lower O&M costs. We found no insurmountable constraints that would preclude USACE from satisfying these cost-reduction objectives. Through design standardization, all of these cost and noncost objectives can successfully be met.

### **Design Cost Savings**

The USACE is experiencing increasing pressure to accomplish more within its existing design budgets, and those budgets are expected to decrease in the future. As a result, USACE needs to take every available opportunity to reduce costs. The effective use of design standardization is one way that USACE Districts can continue to perform the same quality of design with fewer resources. However, current

USACE procedures used to design standard facilities do not routinely result in design cost savings. USACE Districts need a fresh perspective and new operating procedures when dealing with standard facilities.

Standardization results in lower design costs only when the same architects and engineers are involved in the design process. This is not the Districts' standard mode of operation. For example, standard facilities are either designed in-house or sometimes, because of limitations on in-house design effort, performed under contract with an A/E firm. When contract support is needed, these A/E firms are frequently selected to design standard facilities without considering their previous experience on a particular standard facility type. Because A/E firms are ultimately liable for the completed design, they establish their fee on the basis of full verification of the standard design work -- verification that was previously completed by another A/E firm or COS in developing the standards. As a result, their fee is the same as it would be if the firm developed the design without the benefit of standards. For this reason, USACE began using the "Special Design Instructions" form to recommend in-house design of standard facilities when the design directives are issued to the cognizant District. The goal was to retain liability for the standards "in-house" and therefore not pay for the verification of the standard design work already completed during the standard's development.

Thus far, this policy of in-house accomplishment has not routinely reduced the effort required to complete a project utilizing a standard design. At least, it has not done so to the extent realized in the private sector. One reason is that in-house architects and engineers find that the additional effort needed to track down the standard package and coordinate the standard design with the cognizant COS reduces the potential savings from the design development already accomplished on the standard. Also, in USACE's current configuration, Districts are not designing enough standard facilities in-house to become familiar with them, and some in-house architects have found that the standard definitive packages are not developed to point at which they can actually save design effort. For these reasons USACE needs to adopt new methods that will create an operating environment in which saving design costs can occur routinely.

In the private sector and some public sector agencies design fees are reduced on a regular basis and their reduction is a real secondary objective of the program. These fees are reduced by utilizing only in-house designers or by establishing an



ongoing relationship with one or several A/E firms so that when such services are needed, the A/E firm has already verified the reliability of the standard design work, developed a complete set of construction drawings for the standard facility, and assumed liability for the design work. As a result, those A/E firms are able to pass the reduced liability to the firm in terms of lower design fees. When such a relationship exists, subsequent designs for the same facility type may result in 40 to 80 percent lower design fees. Also, since standard designs significantly reduce the time and effort needed to develop conceptual alternatives, A/E firms are willing to lower fees even further. Only through this repetition by a single design agent can USACE expect to achieve additional savings in design through standardization. Therefore, if USACE expects to lower design fees, it must change the procedures it follows in implementing standard designs and modify the procedures it uses to select A/E firms.

We see four alternative procurement strategies for USACE that would create an environment in which lower design fees could be realized. First, USACE could mandate that all standard designs be done in house by the operating USACE district. Second, COSs could become the sole design agent for all projects utilizing the facility types under their supervision. Third, COSs could establish indefinite quantity contracts with outside A/E firms, and those contracts could be used on a nationwide basis to design all of a particular standardized facility type. Finally, USACE Districts could modify their current A/E selection criteria to place a higher weight on familiarity with standard designs.

The first three alternatives pose some difficulties. If, for example, COSs designed projects for other USACE Districts on a reimbursable basis (either by COS or by contract), then determining which District receives credit for the design work could be troublesome. Also, the FAR limits indefinite delivery contracts to \$500,000 per year and \$200,000 per individual delivery order. On a nationwide basis, it would not be long before such limits were reached. Also, these methods complicate the District's normal design procedures and make procedures for implementing projects using design standards unnecessarily cumbersome. Mandating that any of the alternatives be used exclusively, diminishes the flexibility Districts would have when using standard designs, particularly when the normal operations at USACE Districts places such high demands on flexibility. All these problems would be

compounded even further as the Army's standardization program expands and an increasing percentage of a District's workload is dedicated to standard facilities.

Therefore, we recommend a strategy in which in-house resources would be supplemented by outside A/E support. The goal would be to make sure that the design agents, either in-house or under contract, have the opportunity to become familiar with designing a particular standard facility. When outside support is necessary, Districts can create an opportunity to save design fees by selecting A/E firms that are experienced in designing standard facilities. For this to occur, most Districts would have to modify their A/E selection criteria to include familiarity with the particular facility type. Although the Brooks Act discourages the selection of A/E firms on the basis of cost, it does not prohibit experience with a particular facility type as a selection criteria. However, the mere selection of an A/E firm experienced with a standard facility type does not in itself guarantee lower fees. The ensuing price negotiations with the A/E firm must include discussions of its reduced liability and required design effort. From the District's perspective, the A/E firm's fee should be lower because the conceptual development phase is nearly complete when standard designs are used, the A/E firm has already completed the design at least once, and the A/E firm has assumed the liability for the design on preceding projects. Such price negotiations are legitimate as long as they are "fair and reasonable." Our experience with similar design standardization programs in the private sector suggest that repetitive designs result in cost benefits to both the A/E contractor and the owner, and as a result, A/E firms are open to such negotiations.

The main advantage to this alternative is that the procedures for designing standard facilities are not much different from the procedures for normal design activity. The main difference is that Districts need to modify their A/E selection criteria in the *Commerce Business Daily* announcement. All other procedures remain virtually the same as for normal design activities. This strategy also gives the Districts implementing standard designs the same level of flexibility to balance in-house work performance that they enjoy now because it does not mandate the method of design execution.

Implementing this strategy will require the creation of a short list of familiar A/E firms experienced with designing standard facilities. USACE would need to establish a data base of responsive A/E firms that have successfully designed standard facilities. The DA Facilities Standardization Program's Phase II imple-

mentation effort just getting under way offers a perfect opportunity to collect the necessary information. As a result, when design directives are issued to the Districts, a list of responsive and experienced A/E firms can be included. The Districts, at their discretion, can include those firms on the bidder's lists when the District chooses to design the standard using an outside A/E firm. When no such experienced A/E firm exists or when other selection criteria weight more heavily in the selection process, then the District should select another firm (one that is not familiar with the facility type). However, on the subsequent project using the standard design, certainly at least one A/E firm will have the requisite experience.

### **Construction Cost Savings**

All the design standardization programs we examined claim to reduce construction costs for several reasons. First, because of the nature of the standardization programs, the facility designs undergo constructibility and value engineering reviews that may not otherwise exist. As a result, more cost-effective design solutions become part of standard facility designs over several design iterations. Second, experience with multiple construction projects means that feedback mechanisms can be established to fine-tune the design's constructibility and significantly reduce design errors and the time needed to correct them. Third, since the owner gains experience with programming, designing, estimating, and managing construction of these standard facilities, construction cost growth can be minimized. By institutionalizing good design solutions that can be cost-effectively constructed, it follows that all projects using standards will be more cost-effective. However, private-sector experience dictates that construction costs can be lowered even further by hiring construction contractors who are experienced with building standard facility types. Having constructed similar facility types, the construction contractors will have already learned cost-effective solutions for constructing the facility. These cost savings can be passed along to the owners during the bidding process.

The market for construction services ensures that construction contractors experienced in building standard facilities will offer competitive bids. Our experience with some private sector companies is that construction contractors are sometimes willing to reduce their price on first-time projects just to gain the required experience to enable them to compete cost-effectively on following projects. Either way, USACE receives a fair bid for the job as long as experienced construction contractors are invited to bid on projects that use standard designs. Districts must

know which construction contractors have built standard facilities so they can be on bidder lists. Therefore, USACE must establish a data base of construction contractors who have constructed standard facilities. This could be part of the same data base discussed in the previous section and should become part of the DA Facilities Standardization Program Phase II data collection effort.

### **Improving Selection Procedures**

Obviously, not all of the Army's free-standing facilities are candidates for standardization. USACE has to determine which facilities should be standardized, which design elements need to be locked in and which can remain flexible, and the level (design criteria and specifications, modular design, definitive designs, or 100 percent designs) at which those facilities should be standardized. Currently, the CEMP-EA holds informal meetings with the proponents of potential facility types and at those meetings evaluates the candidate facility types. The participants in those meetings agree on whether particular facility types should be standardized and their anticipated level of standardization. Using their experience, the facility type subcommittee later determines the actual level at which to standardize. Although this process has been effective in the past, as the program grows, its informality may lead to inconsistent results, and the approach may not be effective in determining the appropriate level of standardization, particularly as new CADD development techniques are employed.

The Corps needs to reexamine its process for determining which facilities should be standardized, the appropriate level (100 percent designs, definitive designs, modular designs, or criteria and specifications only) at which to standardize them, and the most cost-effective method (CADD, definitive-level kit-of-parts, 100 percent kit-of-parts, or manual drafting) for developing them. A more detailed cost-benefit analysis should be used to support this decision process and should be documented in existing standard operating procedures. This cost-benefit analysis must compare all the additional costs to standardize a facility type with all the potential benefits, and it must recognize the expected number of standard facilities being constructed in the outyear MILCON program.

The additional costs to standardize a facility include the costs of the facility type selection process, standard design development with consideration of the level and methods of development, and standard maintenance. The potential quantifiable

benefits include higher facility productivity, reduced life-cycle costs, and reduced time to design and construct, to name a few. In addition, the USACE cost-benefit analysis should recognize a qualitative assessment of the importance of simplified planning and programming as well as consistent facility appearance and quality. Once this heuristic process and cost-benefit approach are finalized, they must be incorporated into the appropriate standing operating procedure and other documentation to serve as the template for future standard facility selections.

### **Establishing a Productive Environment**

To support both current and proposed objectives for the DA Facilities Standardization Program and to improve the program even further, USACE must make sure that a productive operating environment is available. First, the highest Army staff authorities must continue to support the program if it is to continue to flourish. Headquarters USACE must make sure that the Army staff is periodically reappraised of the program's successes, the Armywide advantages of the program, and the benefits of the program to USACE. The data collection effort that constitutes Phase II of the program is just underway at HQUSACE and is the ideal platform to ensure that periodic upward reporting occurs.

Second, USACE Districts designing standard facilities and COSs developing standard designs need to be better informed about the objectives of the program; their responsibilities under the program; the procedures used to select, develop, implement, and maintain standard designs; and the potential benefits they and the Army may realize as a result of successful enactment of the program. For the program to continue to succeed and for a productive environment to be created in which design costs and construction costs can be routinely saved, the Districts and COSs must fully embrace the program and participate in it.

### **Organizational Support**

Although direct comparisons are difficult, the amount of effort the Army devotes to its standardization program is similar to the amount of effort expended by private-sector companies. Like the private sector, the Army does not (and should not) create a separate organizational element with a dedicated staff responsible solely for the design standardization program. Rather, it supports its program in the context of

normal day-to-day design activities through several committees, subcommittees, and Engineering Districts.

The private-sector experience shows that without a standardization program a larger design staff would be needed; in fact, we saw several standardization programs that were successfully implemented to reduce corporate-wide manpower. In particular, when standardized, those aspects relating to preliminary facility programming, design development or design review, and implementation of a project should require less effort than would be needed for a unique design process.

In the private sector, design standardization is generally a top-down management mandate, and as a result, senior management enforces its execution to maximize the program's objectives. Committees of staff personnel and senior management make decisions on the approval of standard designs (and standard criteria) and their subsequent updating. Similarly, to meet facility standardization objectives, the Army's top management must make and enforce decisions on which facilities to standardize, which standard design packages to adopt, how and when to implement standard designs (and deviations from the standards), and when to update them. A certain degree of committee involvement is necessary to ensure total compliance by the many facets of the Army community.

## RECOMMENDATIONS

We recommend that HQUSACE make the following improvements to the DA Facilities Standardization Program so that it continues to meet its objectives, its benefits continue to justify the additional costs, and the operating environment needed to support the existing and proposed program objectives is created:

- *Modify the current set of facility selection decision rules.* These decision rules should utilize a structured cost-benefit approach that determines which facility types should be standardized and what constitutes the appropriate level of standardization. In "standardizing" a facility type, additional costs are incurred in selecting the type of facility, developing the design, and maintaining the standard. The development costs depend on whether standardization includes criteria and specification, functional modules, definitive-level designs, and/or 100 percent-level designs; those costs also depend on whether the standards are developed manually, with CADD system technology (including kit-of-parts), or with a combination of both. The determination of potential benefits must include facility productivity enhancements, expected savings in design and construction costs, and a subjective assessment of intangible benefits (consistency, quality, simplified

processes, etc.) for the total number of facilities expected to utilize the standards. The final set of decision rules and cost-benefit approach should be drafted and incorporated into the current standing operating procedures.

- *Modify existing A/E selection criteria to include experience with the proposed facility type.* Adopting this policy creates an opportunity for USACE Districts to save on design fees when standards are used. The selection of an experienced A/E firm does not in itself guarantee that design fees will be reduced on standard facilities. However, "fair and reasonable" negotiations between the USACE District and A/E contractor after the selection process should include discussions of lower design fee based on the A/E firm's reduced conceptual design development requirement and the A/E firm's previous experience designing the standard facility and verification of design work already completed.
- *Expand the DA Facilities Standardization Program's Phase II data collection effort to record A/E firms and construction contractors that are familiar with designing and constructing particular standard facilities.* The purpose of the program's Phase II implementation is to enable USACE to evaluate and continually justify the program to Congress, OSD, and the DA staff. Only through continued top-down support can the program remain effective. In addition to helping to justify the program, this expanded data base can also be used to monitor A/E firms and construction contractors that are experienced with standard facilities. A list of experienced contractors can then be issued to the cognizant USACE Districts through the project design directives when standard facilities are mandatory. Districts can use this information to ensure experienced contractors are included on the bidder's lists. This entire Phase II data base should be developed and maintained by the Architectural and Planning Branch at HQUSACE.
- *Develop a program to better communicate the objectives and potential benefits of design standardization to the COSs, USACE Districts, and facility users.* The success of the Army's design standardization program depends on all the players fully embracing the concept. It depends particularly on the COSs and Districts that develop and implement design standards and on the users who must participate in the design process and operate and maintain the facilities. As a result, HQUSACE should ensure that all standard operating procedures, regulations, and pamphlets are updated and that they reflect the program's most recent experience; the responsibilities of all committees, subcommittees, COSs, and Districts managing the program; the procedures used to select, develop, implement, and maintain standard designs; and the actual and potential benefits to the Army. We further recommend that HQUSACE effectively highlight each of those issues in an information brochure prepared specifically for USACE Districts and COSs. The brochure can also be used to effectively market the design standardization concept to potential facility users.

- *Further investigate the opportunities CADD technology brings to the program.* USACE is already advocating use of CADD technology and mandating that all future standard facilities be developed on CADD systems. Its use will simplify developing, maintaining, and transmitting standard design packages. However, additional opportunities are also available to further improve the design standardization program. When selecting facilities to standardize, USACE should examine the cost-effectiveness of using at least definitive-level kit-of-parts (or 100 percent, if cost-benefit analysis shows adequate justification) for those facility types for which a high degree of flexibility is desired, user participation is particularly important, and/or a large number of facilities is planned.



**APPENDIX A**

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## **STUDY PARTICIPANTS**

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**APPENDIX B**

**PRIVATE-SECTOR DESIGN STANDARDIZATION  
PROGRAM PROFILES**

## **PRIVATE-SECTOR DESIGN STANDARDIZATION PROGRAM PROFILES**

### **AFFORDABLE INNS**

Affordable Inns is a budget motel chain owned and operated prior to 1989 by its founder, an architect/engineer (A/E). It developed 53 budget motels in the midwest in the 1970s and 1980s before being sold in 1989.

The company was started with design standardization in mind, and its objective was to reduce the total costs of design, construction, and maintenance so that operating requirements and performance could be controlled. The consistency of design and construction permitted strict monitoring of operational performance and continual feedback on building quality and operation.

Standard designs were maintained at the definitive drawing level (defined in Chapter 1 of the main text), but room modules were more highly developed. Individual projects were implemented by a sole-source general contractor who was responsible for site adaptation of the standard designs. The standard designs changed little over 20 years, but no two sites are identical.

### **ALAMO RENT-A-CAR CORPORATION**

Alamo owns and operates more than 90 car rental sites nationwide. Facility types include customer service areas, maintenance shops, fuel stops, and car washes. Alamo's design and construction program is growing by about 8 sites per year. Real estate acquisition, facility design, and construction are the responsibility of a fully owned subsidiary of Alamo's parent company called Dkbert Associates.

The design standards program has been around for about 5 years. It rests entirely on a rather strict set of design criteria maintained in a *Standard Specifications Guide* and on functional modules (for most facility types) maintained as definitive drawings in hard copy only. The car washes, maintenance facilities, and refueling stops are more highly standardized than the customer service areas because they do not need to change much from site to site. The program's goal is to provide highly productive and cost-effective facilities with a consistent image.

## **BURGER KING CORPORATION**

Burger King operates one of the largest fast food outlets in North America. The company has between 3,000 and 5,000 sites, with an annual construction rate of 220 stores per year. About 85 percent of its restaurants are franchises and the rest are company operated.

Design standardization has been standard operating procedure since the company began. In the past, standards were maintained at the construction level but lack of flexibility and control forced them to maintain the standards at the definitive level. The headquarters design and construction staff of six persons is responsible for developing and maintaining the standard designs that the company provides to field offices for implementation. The regional offices involve local A/E firms with specific projects. Local A/E firms prepare the construction drawings and oversee construction, and Burger King's headquarters staff monitors compliance with the standardized design and continually evaluates the quality and effectiveness of the designs. The objective is to design a highly productive and cost-effective building for producing and selling fast food.

## **EXXON CORPORATION**

The part of Exxon Corporation in which we conducted interviews is responsible for all of Exxon's retail outlets, which include service stations, car washes, convenience stores, and combinations thereof. There are three possible options for any new facility construction: (1) independent owners (approximately 3,500 facilities), (2) Exxon-owned but independently operated (approximately 8,000 facilities), and (3) contract accounts (about 500 facilities). The retail portion of Exxon has been growing at a rate of about 150 new service stations annually.

Exxon's design standardization program has been around since 1983. Before that, each of five independent regions was responsible for the design and construction of new facilities in its region. Each region had five to six people. Exxon headquarters retained little control. In 1983, a centralized function was created to reduce the total manpower (down to nine people total) and generate a highly centralized control of standardization.

The standardization program relies heavily on the prefabrication of the facilities. An outside building manufacturer is contracted to build the facilities per



specification and deliver to the job site. The building contractor assumes all liability for the building design. All Exxon retail facilities are maintained at about 80 percent design complete. The power of their computer-aided design and drafting (CADD) allows them to store more than 100 varieties very easily with a number of simple standard options for each variety. Site information is extracted from the owners through surveys.

Owners may deviate from the design standards with just cause, but they must bear the cost of the design effort (about \$20,000 to \$30,000) and have the plans reviewed and approved by headquarters. Critical design elements must still be incorporated.

#### **HERTZ RENT-A-CAR CORPORATION**

Hertz is this country's leading automobile rental company with more than 500 sites throughout North America. New construction has recently been slowed until the economy improves. Hertz designs and constructs a number of standard facility types including car customer service facilities, vehicle maintenance buildings, car washes, refueling stations, and canopied parking areas.

Hertz's standardization program is a combination of standard criteria, definitive drawings, and highly developed functional modules for such facilities as automobile service bays, car washes, and fuel islands. Hertz controls consistency by using an in-house architect to prepare a site plan and preliminary drawings; it then supervises a local A/E firm in preparing construction drawings. Hertz consolidated and updated standard design documentation this past year to ensure good performance from each building, but the design does not emphasize any consistency in image or commonality of maintenance requirements. Strict signage and standardization of customer area interior finishes is the key to visual identification.

#### **KINDER-CARE LEARNING CENTERS, INCORPORATED**

Kinder-Care is about 22 years old and it has constructed more than 1,400 learning centers nationwide. Its goals were to have a well-defined image for providing both day care and a learning environment for children aged 6 weeks to 12 years. About 1,300 centers are still operating, but the rest have been phased out of operation. Kinder-Care designed and built about 120 new facilities last year, but the current economic downturn knocked new construction down to about 14 in 1991.

New construction in the near future looks even leaner. Each new facility is constructed in 60 to 90 days.

Kinder-Care's design standardization program started about 18 years ago for marketing reasons — it wanted cost-effective quality facilities and instant recognition. It currently maintains standard designs at the definitive level for about four types based on size, but it calls the 164-child center its prototype. The drawings are highly automated on an AUTOCAD system, and new conceptals (showing elevations, floor plans, and schematics) can be developed in about 2 hours. Designs are site-adapted in house, and within 2 months, a set of construction drawings can be ready to go. Final drawings are all signed by an outside architect (the same one who developed the prototype). The AUTOCAD system has some built-in programs that support local codes and site conditions, and the program can automatically adjust the building dimensions based on the expected number of children and local space/child standards.

#### **LA QUINTA MOTOR INNS**

La Quinta develops and operates motor hotels, typically with fewer than four floors. The company has about 200 properties nationwide but concentrates on cities in the South and Southwest. La Quinta has been constructing between 14 and 30 new hotels per year, but it has recently reduced new construction to zero until the economy and the hotel industry improve.

La Quinta's design standardization program originated with about eight prototype designs, but it now uses only about two basic standard designs maintained at the definitive level (interior and exterior corridor types). Each design has standard options for the number of floors, wings, etc., and can vary depending upon site. Local A/E firms are contracted for implementation of the standard designs, do the foundations and civil work, and ease the permit process.

#### **MARRIOTT CORPORATION**

Marriott Corporation develops, owns, and manages hotels (Marriott Hotels, Courtyard Hotels, Residence Inns, and Fairfield Inns), restaurants (it just sold Roy Rogers), and other food service properties throughout the United States. Although new construction has been curtailed recently, during the 1980s Marriott Corporation undertook \$800 million to \$1.4 billion in new construction each year.

Marriott initiated its design standardization program in the 1960s. The standards were codified in 1969 and have evolved ever since. Each facility type has its own standard criteria notebook — about 8 inches thick — containing very detailed sets of design criteria for finishes, equipment specifications, materials, etc. Marriott has no desire to standardize its hotels beyond this level. Marriott wants an upscale image. For the other facility types, each notebook contains functional design criteria as well as standard designs maintained at the definitive level. For Courtyard Hotels, the most ambitious of its standardized facilities, the standards are maintained at a fairly high level (some construction details).

Design standardization documents are developed and maintained by the Architecture and Construction Division, while individual projects are implemented through outside A/E firms. The emphasis of the program is on efficient building operation, image, quality, and construction and life-cycle costs. Its goal is to be the lowest cost operator within their market niche.

#### **McDONALDS CORPORATION**

McDonalds is the country's leading fast food chain. It has thousands of stores, and most stores are owned and operated by private owners. The current recession is holding new construction down, but still about 400 new stores are constructed annually.

The design and construction of McDonalds' restaurants has always been standardized in one form or another. Currently, it maintains 15 variations of its restaurants as construction drawings. Each standard design has standard options for seating, storage, drive-throughs, rest room size, etc. A headquarters staff of 11 is responsible for developing and maintaining the standards, but implementation is left to regional offices that contract with local A/E firms for the site adaptation of the standard. The main objective is to design the most operationally productive facility at the lowest possible cost to the owners and thus be as profitable as possible for a given sales volume.

#### **PIEPER O'BRIEN HERR ARCHITECTS**

Pieper O'Brien Herr (POH) Architects, a firm with three principals and three associates, was formed in 1976. It practices throughout the United States but mostly in the Southeast. POH specializes, in part, in developing prototype designs for such

companies as Volkswagen, Nissan (the Infinity program), and the Presbyterian Church of America.

Basically, the company maintains the standard designs at the conceptual to 50 percent level because any more detail becomes difficult to maintain and hard to manage when implementing designs at many geographically separate sites. The standards are maintained in notebook form and delivered to potential clients as hard copy. Also, if designs were maintained in any more detail, POH would have difficulty passing liability on to the A/E firm that actually completed the design.

### **PIER 1 IMPORTS**

Pier 1 is a 30-year-old retail merchandising firm that owns and operates about 585 stores nationwide and in Canada. In 1985, Pier 1 had only 265 stores, but expects 1,000 stores by the Year 2000. Some of the stores and land are leased while others are corporate owned. Pier 1 opened 85 new stores in 1990, 27 more than it opened in 1987.

Pier 1 maintains several prototype designs at the definitive level — 8,000-square-foot, 9,000-square-foot, and 10,000-square-foot varieties. The standard design packages include design criteria and prototypical designs, which specify shape and dimensions, physical image, material and equipment specifications, and internal displays. For a given site, a headquarters staff of 2 prepares preliminary drawings. Four project managers oversee preparation of construction drawings and the field supervision of the actual store construction. The construction drawings are prepared by one of two A/Es on retainer to the firm. Display areas and stock rooms were both highly standardized. The standard designs have evolved freely since 1985.

### **SATURN CORPORATION**

The Saturn Corporation is a new independent corporation formed by General Motors to revolutionize how and what cars are made in America. Saturn initiated a very large research program to study automobile sales and marketing. Part of the Saturn concept was to develop a totally new showroom/service facility that changes the typical image portrayed by other dealerships. It plans to open about 500 to 700 such showrooms and has embarked on a design standardization program to do so. At present, about 100 sites are open and about 40 to 70 will be completed in 1991. All such dealerships are franchise operations.

Saturn's design standardization program has changed dramatically in its short life. At first, the "greenfield" sites (about 55 percent) were very highly standardized at nearly 100 percent design complete and only needed slight modifications for site conditions. The plans were developed and managed by an outside A/E firm. However, Saturn soon found that this level of detail could not be efficiently implemented and abandoned it for a less detailed definitive level of design development.

Standard facility designs are now maintained at the 50 percent design complete level together with a set of standard specifications for equipment and materials. Facilities that are standardized include showrooms, display lots, landscaping, service bays, car washes, and signage. The front wall and canopy are especially strong visual components and the floor plan is critical to Saturn's sales objectives.

Two headquarters staff are responsible for working with regional offices, local owners, and the A/E firms to ensure compliance with the standard for each site.

#### **TEXAS A&M UNIVERSITY**

Texas A and M is a large university with about 40,000 to 50,000 students. It has a main campus and two remote campuses. Facility types range from dormitories, basic classrooms, and laboratories to special-purpose facilities. The current construction program is around \$79 million with 16 individual projects. Fifteen projects are in the design phase or bid phase, estimated at \$147 million, and 9 projects are in the programming phase, which totals \$89 million. Very little growth is expected in the coming years.

Texas A and M has two levels of design standardization. First, it maintains a fairly extensive set of design criteria for the design and construction of all facility types campus wide. The design criteria are used to keep all new construction consistent from one building to the next. The criteria are issued to A/E firms during the selection phase to minimize miscommunication and surprises during the design phase. The criteria include space standards and allocations to ensure consistency and keep new construction costs down. Also, standard materials and equipment keep the new construction consistent and that avoids overly high storage of spare parts, reduces training costs, and ensures lower maintenance costs. Each new standard is analyzed for its effect on life-cycle costs of the facility.

The university's second level of standardization is a functional module approach to designing and constructing new dormitories. The program has been in existence for several years and was implemented to ensure higher quality dormitories and to reduce the time needed to construct new dormitories. The program was not implemented to save construction costs or design fees although it has resulted in a 10 to 15 percent reduction in construction costs and 50 percent reduction in design fees. Pre-engineered and prefabricated concrete modules are finished ("sheetrocked," wired, plumbed, and fixtured) at the contractor's site and shipped to the dormitory site, where cranes stack them in place. As a result, dormitories can be built in about 60 percent of the time (6 to 8 months; down from 14 to 18 months) otherwise needed. The modular construction is less than 10 percent of the total workload.

**APPENDIX C**

**OTHER GOVERNMENT DESIGN STANDARDIZATION  
PROGRAMS**

## **OTHER GOVERNMENT DESIGN STANDARDIZATION PROGRAMS**

### **ARMY & AIR FORCE EXCHANGE SERVICE**

The Army and Air Force Exchange Service (AAFES) is responsible for all marketing, retail supply distribution, contracting, and facility acquisition to support its worldwide retail operations on Army and Air Force installations. The responsibilities for the planning, programming, design, construction, operation, and maintenance of its retail facilities rests with the Customer Facility and Facility Support Directorates. AAFES manages about \$150-200 million construction program annually, most of which is derived from earnings on retail sales. About 50 percent of their construction budget is used for new construction.

The AAFES operates about 17,000 facilities covering every state in the United States as well as in 26 countries worldwide. These facilities support any one of 17 separate businesses including retail facilities (base exchanges and shopettes), food service (Burger Kings, La Casa De Amigos, Anthony's Sweet Reflections, etc.), personal services (barber shops, beauty shops, dry cleaning, opticians, florists, portrait studios, etc.), and automotive service stations. The AAFES also constructs mall-type facilities to house a mix of the personal service, food service, and retail operation facilities under one roof.

The AAFES has implemented a broad design standardization program in reaction to its highly diverse facility construction program. Its primary objective is sales performance to increase earnings. Like private-sector companies, AAFES feels that design standardization increases earnings through consistent image (i.e., recognition) and quality construction (materials, finishes, displays, etc.). At the same time, design standardization reduces the time it takes to design and construct facilities (which means facilities can be open sooner and begin generating earnings sooner) and controls life-cycle costs (programming, design, construction, and operational maintenance).

The AAFES standardization program finds its roots back in the 1960s when the Service was primarily concerned with interior design aspects and developed



standards and criteria that related to interior function (layouts, displays, finishes, etc.). Since that time the AAFES construction program has evolved and it now standardizes facility designs at various levels for each of its facility types.

- The installation exchange buildings demand a great deal of design flexibility to accommodate AAFES's operational needs and to meet the installation's local design motif. Therefore, design standardization takes on the form of firm design specifications and criteria as well as some functional modules. Architect/Engineer (A/E) firms are usually hired to design the exchange buildings under the required guidance but are generally free to exercise a certain degree of creativity on the architectural appearance of the facility. Definitive-level standard designs are not applicable to these facility types.
- The AAFES food service and personal service facilities are generally more highly standardized. For most the facility types, the standardized design development is taken to about 50 percent design completion (definitive plus) but in some cases it is taken to the 95 percent level of completion. Although these food service and personal service facilities are designed like freestanding facilities the normal application is to integrate them in a mall arrangement. The final design development, site-adaption, and architectural integration of the various modules into a mall is left up to the contracted A/E firm. The A/E firms have a certain degree of freedom in the designs of the exterior shell, as long as it meets the AAFES standards and the installation's architectural requirements. The AAFES is currently constructing about 20 of these malls worldwide.
- The AAFES also works with national food service franchises to develop design standards that work well for both parties. The standards must satisfy AAFES's strict requirements but, at the same time, satisfy the franchises' high standards and image requirements.

So far, AAFES has not quantitatively evaluated the success of its program but it does feel that the design standardization program has satisfied its intended objectives. For example, many customers perceive AAFES food service activities as commercial ventures (recognition). Although little quantitative data were available, it appears as though the program also reduces life-cycle costs of the facilities. For example, facility planning and programming has been simplified and it is easier to design, construct, and maintain facilities than would otherwise be true. Also, since AAFES is able to select A/E contractors that have worked with it before, some design fees on projects have been reduced by as much as 50 percent when the A/E firm is familiar enough with a particular design to effectively use CADD. Also, since the AAFES is able to specify brand names as a determination of the minimum level of

quality required, it saves some costs in construction materials because its procurement group is able to negotiate on bulk purchase of materials via requirements-type contracts. Lastly, the time required to design and construct the facility has been shortened because A/E firms are familiar with the designs (AAFES is able to contract with A/E firms that are experienced with AAFES facilities) and the standards eliminate the need to develop conceptual alternatives.

## **DEFENSE COMMISSARY AGENCY**

The Defense Commissary Agency (DeCA) is a recently-formed tri-Service organization established to support all commissary operations worldwide. Responsibility for planning, programming, designing, and constructing new facilities rests with the Directorate of Facilities. DeCA's annual new construction program ranges between \$100 and 140 million per year which provides about 12 to 18 new facilities.

The Air Force 3303 Procurement Group supports DeCA's new facility acquisitions. Because of the importance of getting new facilities open as quickly as possible, all new facility procurements will use design-build contracts. With the exception of some standard design development, no in-house design effort is expended. About 25 full-time equivalent (FTE) personnel manage DeCA's design and construction program, and about 22 FTEs plan, program, and define construction activities (e.g., site acquisition and standards development).

During the formulation of DeCA, plans called for utilizing standard designs for all new facility construction. DeCA borrowed much of the previous commissary standardization from the Services' effort. Because DeCA is a Defense-level agency, its design standardization program's main objective is to ensure consistency in operations (facility productivity) and quality across the Services. DeCA wants to make sure that all commissary facilities are designed to last 30-50 years and to make sure that commissaries are opened as soon as practical by reducing acquisition, design, and construction time. This approach enables the commissaries to be open for business sooner than would otherwise be possible.

To meet its objectives, DeCA develops and maintains its standard designs at the definitive level, or about 10-15 percent design complete. It currently has eight different standards packages that represent eight different sizes of commissaries (ranging from 30,000 square feet to 100,000 square feet). Each standard package

contains a floor plan with supporting back-up data and standard construction criteria and specifications.

The DeCA feels its design standardization efforts are extremely beneficial. The program's objectives are generally being met as evidenced by the consistency and quality of all newly constructed commissaries and the much shorter design and construction time (benefits that can also be associated with the design-build procurement technique). Design standardization can also simplify the A/E's development of conceptual alternatives. A/E firms no longer need to "feel around in the dark" at the beginning of the design process. Also, the number of change orders in the design and construction process has been reduced. As a result of design-build and design standardization typical 36-month design and construction projects are being completed in 15 months.

## **FEDERAL BUREAU OF PRISON**

The Federal Bureau of Prisons (FBP) of the U.S. Department of Justice oversees the operations of this nation's Federal prison system. The Facilities Division is responsible for the acquisition, operation, and maintenance of prison facilities, which at present, consists of 65 correctional institutions (55,000 inmate population). These facilities are classified by level of security — administrative maximum security, high security, medium security, and satellite camp classifications. In addition to the prisons, FBP also designs and constructs staff training centers and staff day-care centers.

In the past, new construction rarely exceeded one new facility per year. However, over \$1 billion has been infused into the FBP for new facilities as the result of the President's crime bill, and this together with other unanticipated funding has resulted in over 35 new correctional institutions (some are complexes comprised of several prison classifications) currently in various stages of development. FBP's future, steady-state new construction program will drop back down to 1-2 new facilities per year when this current funding anomaly is fulfilled.

The FBP began a design standardization program back in the mid 1980s to ensure all newly constructed prisons had consistent quality and consistent functionality. The program has received new emphasis as a result of the significant increase in new construction. Reduced construction or design cost was not an objective of the standardization program although FBP does recognize the need to

control such cost as long as consistency and quality are not compromised. As a result of FBP's objectives, it standardized applicable design criteria and specifications (colors, special relationships, allocations, etc) with some modular design standardization of the prison cells and some standardized site layouts for each of the prison classifications. FBP is currently not interested in extending the design standardization program to the definitive design level. A/E firms developing designs may use previous designs to meet the requirements of the new designs although the reuse of previous designs is not mandated.

## **NAVAL FACILITIES ENGINEERING COMMAND**

The Naval Facilities Engineering Command (NAVFAC) provides design and construction services for the Navy and Marine Corps through seven engineering field divisions (EFDs). NAVFAC's military construction – Navy (MCON) program is expected to rebound to about \$1 billion annually from a 1991 low of \$200 million, which resulted from the defense construction freeze. About 400 active construction projects (in various states of development) are included in the current program. The MCON appropriation represents about 40 percent of NAVFAC's funding – the rest comes from nonappropriated funds, Navy family housing, and reimbursable funds from other Defense agencies. Design placement represents about 8 percent of the construction program.

The EFDs provide all design work and construction management services in NAVFAC. An "average" EFD may have between 60 and 100 FTE staff members for its design effort and double to triple that for construction management. NAVFAC targets in-house design effort at about 20 percent of its available technical FTEs, which results in about 4 percent of its dollar value of design placement. The rest is contracted out to A/E firms. A contract group within each EFD is responsible for design and construction contracting.

NAVFAC has a long history of supporting design standardization in many forms. However, an official design policy letter only formalized the program in February 1991. NAVFAC's main objective for design standardization is to simplify and to reduce the time to plan, program, and design new construction projects; to improve facility quality by institutionalizing good design solutions from previous projects; and to reduce construction costs and time by minimizing construction modifications. To meet the objectives of its program, NAVFAC has implemented

design standardization on several levels including, modular designs, definitive-level standards, 35 percent and 100 percent kit-of-parts, automated site adaptations, and fully developed standard designs.

Ever since the program was formalized, NAVFAC's preferred method of standardization has been automated site adaptations for which existing designs are reused to the maximum extent practical for subsequent designs of the same facility type. Each new design will be developed with site-specific and non-site-specific layers so that the non-site-specific layers can be maintained as the standards and be used on future designs. This method, which relies very heavily on computer-aided design (CAD) technology, gives the users and designers some latitude with the final design. As a result of this policy, NAVFAC does not consume additional effort or resources to select facility types for standardization, develop standard designs, implement the standards, or maintain them than would otherwise be necessary for custom designs.

Since the program has only recently been formalized, NAVFAC has little quantitative evidence supporting the program's success. However, the advocates of the program are sure that it is meeting its intended objectives and they are not planning any dramatic changes in the near future.

#### **U.S. POSTAL SERVICE**

The U.S. Postal Service employs about 750,000 persons to provide mail delivery and postal inspection services nationwide. To support that primary mission, the Facilities Department, which is a headquarters-level activity with about 110 persons, is responsible for planning, programming, and directing real estate and facility acquisitions. In addition, five regional offices with a total of 74 field divisions have the facility operations, maintenance, and other local building responsibilities. Facility Service Centers (located at the regional offices), with about 130 persons each, and Facilities Service Offices, with about 40 persons each, are responsible for facilities design and construction. The need and funding for new facilities is generated out of the regional offices.

The nationwide network of post offices and mail processing centers totals over 38,000 facilities which are classified by size into one of three categories: (1) under 8,000 square feet, which accounts for the majority of the facilities (about 33,000), are usually leased; (2) 8,000-to 50,000-square-foot facilities, which account for about

3400 facilities, are usually owned and operated by the Postal Service; and (3) facilities over 50,000-square-foot (mail processing centers) are also usually owned by the Postal Service. Between 400 and 700 new facilities are constructed every year, most of which are under 50,000 square feet.

The Postal Service's primary objective for design standardization is to simplify and reduce the time for planning, programming, and designing post office facilities while at the same time, offering the local communities the architectural flexibility they demand. Facility standardization is also a way to keep design and construction costs under control. With these objectives in mind, the Postal Service has implemented a total design standardization program on several levels affecting each classification of facilities.

- *Under 8,000 square feet.* Typically, this facility group is represented by hard-copy definitive level designs. In some cases, these definitive packages are designed to a point where they can be used as solicitation documents. Facilities this size do not require much additional design effort beyond the definitive development and site adaptation work.
- *Between 8,000 and 50,000 square feet.* Because of the high visibility, desired flexibility, and high dollar volume of facilities in this category, the Postal Service implemented a kit-of-parts program. The Kit is comprised of CAD-generated specifications and drawings for basic functional modules (six for the post offices) that will create a full set of 100 percent design complete documents for the facility. The set of drawings includes architectural, structural, mechanical, electrical, and plumbing designs with details but do not include site-specific design features. Outside A/E firms are hired to develop the actual designs and site adapt them using the Kit. The Kit combines the adaptability of custom design with the advantages of standard designs.
- *Greater than 50,000 square feet.* For the Postal Service's largest facility types (processing centers), standard design criteria have been developed. They have considered higher levels of design standardization but because they build only 10-20 a year, on diverse complex sites with varying requirements, it is difficult to justify a kit-of-parts or other form of design standardization.

The Postal Service has standard design criteria and specification, applicable to all their facility types and sizes to help institutionalize good design solutions.

The Postal Service's design standardization program is monitored closely by the headquarter's staff and has been successful at all levels. Planning, programming,

and design of new facilities has in fact been simplified, high-quality consistency is ensured, and design flexibility is still possible. As a result of the kit-of-parts program, design times have been reduced from 6 months down to 2 months (designers can get to 35 percent design complete in only two days) and design costs have tumbled from between 6 and 7 percent fees down to between 3.5 and 4 percent design fees in cases where A/E firms are familiar with Kit designs. In addition, construction modifications have been reduced which means potentially shorter construction durations and lower construction cost growth.

The Postal Service will continue to use design standards to the maximum extent as practical. However, they intend to try to make them even more flexible — CAD will help with this augmented objective. The Postal Service may look into pre-engineered facilities and more flexible contracting arrangements with A/E firms and general contractors to supplement their design standardization program.